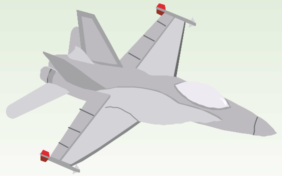

HYPERSPECTRAL CHANNEL SELECTION FOR WATER QUALITY MONITORING ON THE GREAT MIAMI RIVER, OHIO

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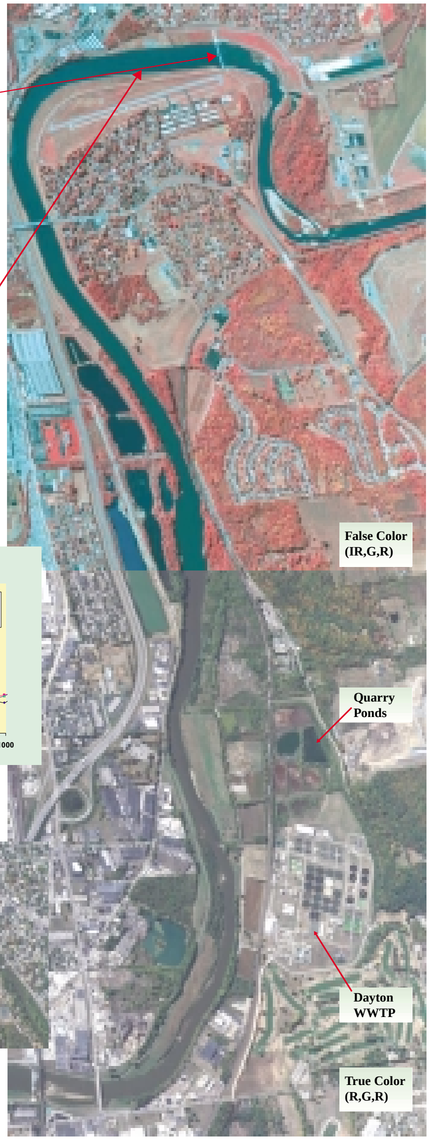
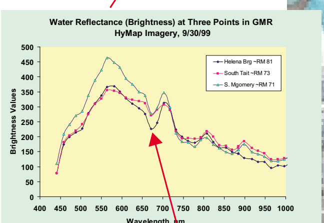
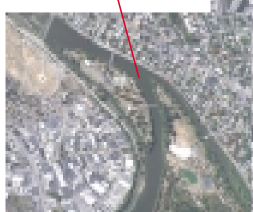
HYMAP RESULTS:

Airborne Imagery of Great Miami River (pixel size: 5 m) - River Mile 69.5 to 75.5

South Montgomery County Low Head Dam







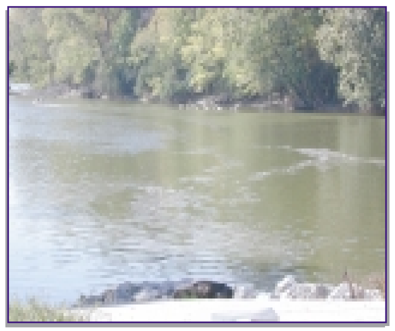
Water Layer Showing Spectral Differences

OBJECTIVE: Develop indicators of nutrient and suspended sediment in deep rivers.

ABSTRACT:

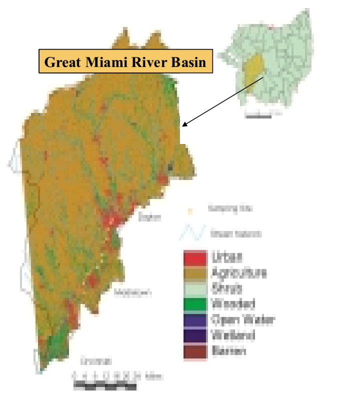
Remote sensing data were successfully used to estimate spatial and temporal variation of optical water quality parameters such as chlorophyll a, turbidity and Total Suspended Solids (TSS) of the Great Miami River, Ohio. During the summer of 1999, spectral data were collected with a hand-held spectroradiometer, a laboratory spectrometer and airborne hyperspectral sensors. Approximately 80 km of the Great Miami River were imaged during a flyover with a Compact Airborne Spectrographic Imager (CASI) sensor. Approximately 10 km were imaged during a second flyover to repeat coverage of the urban/industrial influences around the city of Dayton, Ohio. Instream measurements of water quality data such as turbidity levels, chlorophyll a concentrations, and Secchi-disk depth were acquired on the same days as the flyovers. Relationships between optical water quality parameters and one or two broad wavebands were determined. Wavebands were used for which it can be assumed that the effects of atmospheric characters are either small or can be considered as spectrally additive constants in all wavebands. Where this assumption was not met, (for turbidity) an alternative and theoretically more robust relationship, between the water quality parameter and the first derivative of reflectance was used. Maps of the relative distributions of chlorophyll a and turbidity were created from the hyperspectral images of the river.

STUDY AREA:

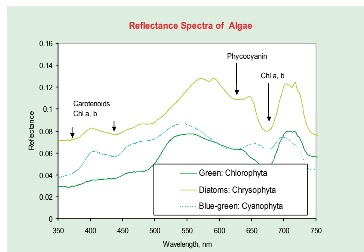


Great Miami River

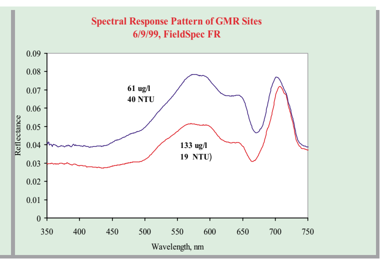
Ohio HUC Boundaries



FIELDSPEC RESULTS



Reflectance response spectra of pure cultured algae. Absorption troughs (low reflectance) in each spectrum are due to specific pigments. The type of dominant pigment determines the location (wavelength) of the troughs. The magnitude of the trough is associated with the concentration level. *Reflectance was measured from a bucket containing diluted cultures.*



Typical reflectance spectra in the Great Miami River. High turbidity values correspond with high reflectance values in the "green" band (around 580 nm) while high chlorophyll values correspond with deeper troughs in the "red" band (around 675 nm). *Reflectance spectra shows similarity with the spectra of diatoms due to their dominance in the River.*

METHODS:

Steps for Developing Hyperspectral Methods to Differentiate and Quantify Algae, Total Suspended Solids and Macrophytes

1. Identify useful hyperspectral channels
2. Develop mathe-matical models to describe interactions and relationships between hyper-spectral data and in-stream parameters
3. Develop spatial distribution maps using remotely sensed imagery

Water Quality Parameters

- TSS, DO, Turbidity, Chlorophyll a, pH, Temperature, Secchi Depth, Algae ID,
- Water Chemistry TKN/TP/NO2/3, NH4

Temporal Study

4 sites within 30 km of river to characterize summer low flow

Hyperspectral Measurements

- The measurement of reflected energy in narrow wavelength ranges of the electromagnetic radiation spectrum
- Above water light reflectance and the underwater light field are measured using:
  1) Hand-held field spectroradio-meter (FieldSpec Fr) scans: 350-2500 nm,
  2) LiCor underwater sensor: (PAR),
  3) Imaging sensors aboard an Aircraft CASI (19 bands, 5 nm): 400-1000 nm and
  4) HyMAP (126 bands, 15 nm): 400-2500 nm

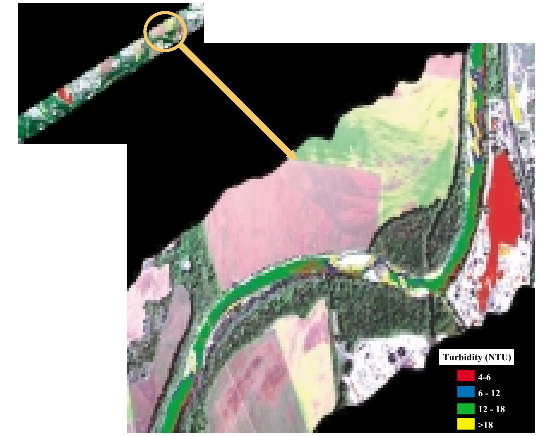
First Flyover: 12 sites over 80 km of river sampled

Second Flyover: 3 sites over 10 km of river sampled

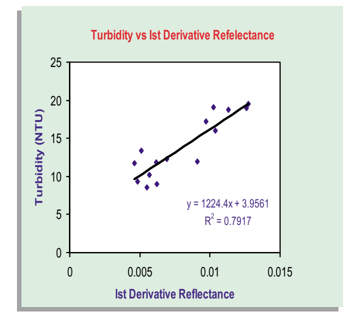
PRODUCTS AND CONCLUSIONS

- ☐ Water quality maps have been produced using image analysis and modeling of hyperspectral imagery from the study area.
- ☐ Hand-held spectral study demonstrated the feasibility of using remote sensing techniques to discriminate and quantify turbidity and algal concentration.
- ☐ It is likely that water quality maps derived from hyperspectral data can be used to calibrate and validate eutrophication in the river.

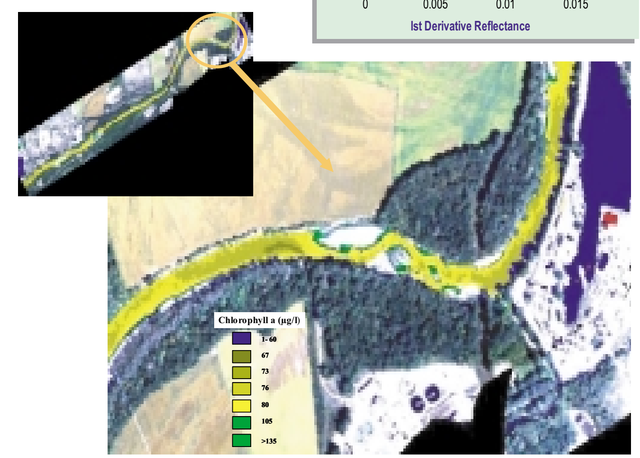
CASI RESULTS:



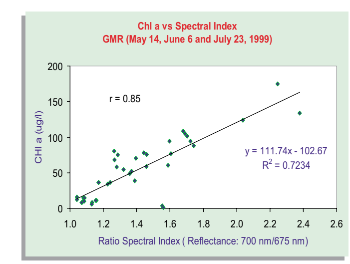
Turbidity Distribution Map



Scatter plot showing a linear relationship between turbidity and a first derivative spectral index.



Chlorophyll a distribution map



Scatter plot showing a linear relationship between Chlorophyll a and spectral index.

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